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**WEAPONS INNOVATION AND JOINT SYSTEM DEVELOPMENT:
A CASE STUDY OF THE JOINT STARS PROGRAM**

by

Stephen W. Hill

Master of Science in Systems Engineering
Air Force Institute of Technology, 1994

Submitted to the Alfred P. Sloan School of Management and the School of Engineering
in Partial Fulfillment of the Requirements of the Degree of

Master of Science in the Management of Technology

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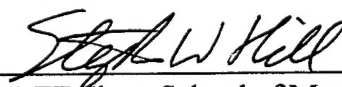
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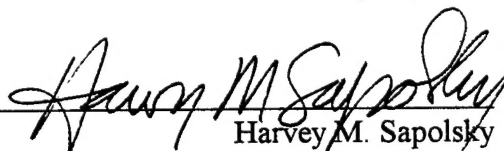
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ABSTRACT

The Joint Surveillance Target Attack Radar System (Joint STARS) is an airborne system developed jointly by the Army and Air Force to provide real-time battlefield surveillance of stationary and moving ground targets. The developmental system made its debut in Desert Storm, where it was praised for its ability to provide wide area surveillance of armored vehicle movements in Iraqi territory. Joint STARS is a joint program that survived in a military where joint programs are very rare. The initiation of the Joint STARS took place at a time when the Army and the Air Force were trying to build a more integrated battlefield doctrine, and the civilian military leadership was seeking to bring the services together on more joint system developments. This atmosphere is not too different from today, and a study of this joint effort offers insight into the process of weapons innovation and joint system development.

Despite the widely publicized success in the Gulf, the system has experienced significant cost, schedule, and operational support difficulties throughout its existence. This thesis examines the difficulties of joint system development and the creation of non-traditional missions, and the effects these had on the Joint STARS program.

This study begins with the early efforts of the individual services to develop their own, distinctive airborne ground surveillance systems and ends with the decision to move into full scale development as a joint system in September 1985. Currently, the joint 19-aircraft program is estimated to cost \$20 billion and is entering its thirteenth year of development and production since the full scale development decision in September 1985.

Thesis Supervisor: Harvey M. Sapolsky

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Mike Husted and Dave Condon at Hanscom AFB provided the essential data to accomplish this study. They both provided access to "ancient" program documents and histories that were really a testament to their love of history (or their inability to throw things away!).

Finally, I thank the interviewees from this study, who all spent much more time with me than expected, given their busy schedules and important roles in business and government. These men were all great contributors to the Joint STARS program and I greatly appreciate their assistance in my efforts to learn about the system's evolution.

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CHAPTER 1: INTRODUCTION

In January 1991, many in the American public as well as in the armed services received their first look at the capabilities of the Joint STARS system. Joint STARS is an airborne surveillance system that provides real-time battlefield surveillance of stationary and moving ground targets, and has the ability to track these ground targets deep into enemy territory. These capabilities were first demonstrated operationally during Desert Storm.

Late in December 1990, General Schwarzkopf ordered the prototype system to the Gulf in time to support the initiation of Desert Storm. During Desert Storm, Joint STARS flew 49 missions in support of the allied forces and was instrumental in identifying the movement of Iraqi armored vehicles and providing this information to ground commanders in real-time to support the interdiction of these enemy forces. Despite the system's status as a developmental program, Joint STARS provided excellent operational support for the allied forces. After the war, General Merrill McPeak, Air Force Chief of Staff, reported, "Joint STARS is a huge success. I am very impressed with what we were able to do with it, and I don't think the United States will ever want to go to a combat situation again without a Joint-STARS-like system."¹

In 1995, Joint STARS was once again pulled out of development to support the peacekeeping mission in Bosnia. Joint STARS provided wide area surveillance of ground vehicle movements to monitor the area for Dayton Peace Treaty violations. Supreme

¹ "Pentagon Weighs Key Reconnaissance Issues Highlighted by Gulf War," *Aviation Week and Space Technology*, April 22, 1991, Vol. 134, No. 16, p. 78.

Allied Commander General Joulwan described himself as Joint STARS biggest fan because of the real-time surveillance support the system provided.²

Despite these widely publicized successes, the program has experienced significant cost, schedule, and operational difficulties throughout its existence. The technology for the system was proven by 1981, yet the system has still not obtained its Initial Operating Capability (IOC) and the program cost is estimated at \$20 billion. In addition, entering the Gulf War in 1991, the Air Force had very little understanding of operational concepts and procedures for the use of the system. In Bosnia, these operational difficulties appeared again as the system operated in a very mountainous region to support a peace-keeping mission that was well short of war.

Joint STARS is an example of a joint program that survived in a military where joint programs are very rare. This thesis examines the difficulties of joint system development and the difficulties of innovative systems that accomplish non-traditional missions. These difficulties provide a clearer understanding of why the program has experienced cost, schedule, and operational problems over the years. A look at these issues also sheds light on why the program has managed to survive despite these difficulties.

Details of the Joint STARS system

The mission of Joint STARS is to “locate, detect, target, and track stationary or moving ground targets, as well as slow flying rotary and fixed wing aircraft.”³ The system,

² “Joint STARS Sets Record,” *Air Force Magazine*, April, 1996, p. 10.

orbiting over friendly territory, provides real-time battlefield surveillance of these stationary and moving targets deep into enemy territory. The system supports interdiction of these targets well before their weapons are in range of friendly forces. Joint STARS is housed on a used 707-300 series aircraft that has been modified to accept the radar equipment.

The Joint STARS radar operates in Moving Target Indicator (MTI) or Synthetic Aperture Radar (SAR) modes. MTI is the primary radar mode for detecting moving targets, and can accomplish wide area surveillance of a corps-size area or sector searches of smaller areas to support concentration on key target areas. SAR is the secondary radar mode and provides image maps and location of stationary targets. A variant of the SAR mode is the Fixed Target Indicator (FTI) mode. FTI postprocesses only the largest radar returns of the SAR, and represents them as targets. FTI is especially useful when tracking certain stationary targets with the requirement to send the target information quickly to the ground. FTI transmissions are much quicker than the transmission of full SAR imagery.

Joint STARS communicates via the Surveillance and Control Data Link (SCDL), the Joint Tactical Information Distribution System (JTIDS), and different voice communications systems. SCDL and JTIDS allows the transmission of the radar data, as well as receives requests from other command and control stations. (The difference between the SCDL and JTIDS link is that SCDL can transmit complete MTI and SAR radar data, while

³ Guerts, Captain James, and Captain James Baker, "Joint STARS: Global Deployment of C4I and Targeting," undated, unpublished paper.

JTIDS can only transmit data processed on-board the Joint STARS aircraft, such as target tracks.)

A Brief History of the System Through 1997

The Joint STARS program began as the result of the consolidation of separate Army and Air Force MTI programs. The Air Force had been pursuing a system known as Pave Mover that provided MTI and SAR surveillance, as well as a weapons guidance mode that could guide tactical aircraft or missiles to targets. The Pave Mover program was preparing to enter full scale development before the consolidation. The Army had built a system called SOTAS, a helicopter-based, MTI-only system that had run into cost and technical problems during full scale development. Despite service arguments about the complementary nature of the two systems, in 1982 the Undersecretary of Defense for Research and Engineering (USDRE) combined the SOTAS and Pave Mover efforts into a joint program called Joint STARS, and designated the Air Force as the lead service for the program.

From 1982-1984, the services, OSD, and Congress wrestled over the development of requirements for the joint program. By March 1984, the services had come to very few agreements on joint system requirements and planned to develop three separate platforms, each with slightly different radar antennas. OSD and Congress were frustrated by the lack of service cooperation and threatened to take funding away from the program. In May 1984, the Chiefs of Staff of the Army and Air Force made the decision to put the Joint

STARS on the 707 and to eliminate the separate Army platform requirement. This was one of 31 "joint" initiatives of the Chiefs which were actually initiatives more along individual service lines than along the lines of joint system development and operations. In September 1985, the Full Scale Development contract for the system was awarded to Grumman Aerospace Company for the production of two developmental Joint STARS aircraft with a plan for 10 production aircraft.

During the late 1980s the program went through several program slips and changes. In 1986-1987, the program experienced significant schedule slips primarily due to problems in radar development, software development, and airframe refurbishment. In April 1988, the Defense Acquisition Board increased the number of E-8A aircraft to be built from 10 to 22, and approved a program plan to use new Boeing 707 aircraft instead of used platforms. By late 1989, however, the cost of newly built airframes jumped because of a production gap between the last 707-based British AWACS aircraft in 1991 and what would be the first production version Joint STARS two to three years later.⁴ The Pentagon approved the re-baseline of the program to use used 707 platforms.

Perhaps the turning point for the program occurred in September and October of 1990. While the House and Senate Armed Services Committees were evaluating whether to cancel the Joint STARS program, the developmental aircraft traveled to Europe to participate in an operational field demonstration. Part of this demonstration included Joint STARS' participation in the Army VII Corps' Operation Deep Strike exercise in

⁴ "JSTARS in the European Skies," *Aerospace America*, Feb 1990, p. 26.

Germany. During the exercise, the Army used Joint STARS data to identify and counterattack an onrushing "Soviet" armor column, played by a Canadian tank convoy. The engagement resulted in some fifty-one tank "kills."⁵

The success and capability of the Joint STARS system was brought to the attention of General Schwarzkopf in Saudi Arabia. In December 1990, a Joint STARS team traveled to Riyadh to brief General Schwarzkopf's staff on Joint STARS' capabilities, and on December 18 the order came to prepare the two prototype E-8As for Desert Shield service.⁶

The aircraft arrived for duty in Saudi Arabia in January 1991, just in time to support Desert Storm. During the war, Joint STARS flew 49 missions in support of the allied forces. Two particular examples are best remembered from Joint STARS' missions in the Gulf War. In the first, Joint STARS provided surveillance support of the battlefield during the battle for the town of Khafji. Joint STARS detected a follow-on force of 80 Iraqi vehicles heading toward Khafji. This follow-on force was engaged and stopped by tactical airpower and the Marine ground commanders knew that additional Iraqi forces would not enter the battle. This was an excellent example of jointness in both calling in airpower to destroy detected forces and informing Marine ground forces that no additional Iraqi forces would play in the battle. The second example was the Joint STARS surveillance of the Iraqi retreat from Kuwait City. Joint STARS provided real-time information of the retreat

⁵ "Joint STARS Does Its Stuff," *Air Force Magazine*, Jun 1991, p. 38.

⁶ "Joint STARS Does Its Stuff," *Air Force Magazine*, Jun 1991, p. 38.

to the air operations center. This information allowed commanders to use tactical airpower to interdict and destroy the slow-moving Iraqi mechanized columns as they used the roads out of Kuwait City.⁷

After the Gulf War, and in light of Joint STARS' success, the Senate pushed to accelerate the production schedule of Joint STARS. The Air Force objected to this decision, feeling that the effort in the Gulf War had not alleviated the need for operational testing and further enhancements. In addition, operational concepts for the system had been developed primarily in the field during the war and needed to be reconsidered. Also the Air Force did not want to commit to the significant increases in funding and manpower that the accelerated program would require. OSD and the House Armed Services Committee (HASC) agreed with the Air Force and the program remained on its existing development schedule.

The next big event for Joint STARS occurred in December 1995, when Joint STARS was ordered to Bosnia in support of Operation Joint Endeavor. Joint STARS' role was to provide wide area surveillance to monitor the area for Dayton Peace Treaty violations. Joint STARS provided information to the NATO ground units to enforce the treaty.⁸ The success of the system in Bosnia has been debated. Joint STARS was operating in a very mountainous environment and trying to track a variety of activities that were well short of war. Although General Joulwan, the NATO Commander, praised the system, the

⁷ "Joint STARS: Information on the Move," *Defense News*, Aug 28, 1995, p. 14.

⁸ "Bosnia - Joint STARS Accomplishes Mission," *Periscope Daily Defense News Capsules*, Mar 22, 1996.

difficulty of this assignment brought into question whether this type of peace mission is the right activity for the Joint STARS system.

In March 1996, the first production aircraft was completed by Northrop-Grumman and turned over to the Air Force, and in September 1996, the Defense Acquisition Board gave Joint STARS approval to proceed with full-rate production of the aircraft. The decision was made for the manufacture of 19 aircraft, including the upgrade of the two E-8A development aircraft. The total cost of the Joint STARS program is now estimated at about \$20 billion as the program prepares to enter its thirteenth year of development and production since the full scale development was made in 1985.

CHAPTER 2: TECHNOLOGICAL DEVELOPMENTS

Army MTI Developments

The Army intelligence community was the first to incorporate MTI on aircraft for ground surveillance of moving targets. In the late 1960s, the Army integrated a MTI Side-Looking Airborne Radar (SLAR) onto their OV-1 Mohawk airplane. The SLAR was able to trace a strip map of the terrain as well as identify moving targets as the aircraft flew across a region. This OV-1 system performed quite well within the intelligence community for many, many years.

In 1968, USDRE initiated the idea of putting a *rotating* SLAR radar on a UH-1 helicopter. This would provide continual scanning of an area rather than the single pass of the OV-1. The Army agreed to build an experimental system, and named the system ALARM for Airborne Long-range Alerting Radar for MTI. USDRE was able to keep the experimental program alive through the early 1970s, despite several Army attempts to zero the program's funding.

In early 1973, Norm Augustine, a strong supporter of the ALARM system, became the Assistant Secretary of the Army for Research and Development. Augustine became the "godfather" of the system at that time and ensured continued support of its development. In 1974, the Army, through the persuasion of Norm Augustine, initiated the Stand-Off Target Acquisition System (SOTAS) program which consisted of two UH-1 Huey helicopters with the ALARM radar working together to vector on a target. Norm

Augustine gave the program management responsibilities for the test program to Bill Kenneally at the Army's Electronics R&D Command (ERADCOM).

Kenneally believed in the technology, but worried about the operational complexity of the SOTAS experiment. He was concerned with the difficulty of operationally coordinating two helicopters in a wartime environment. He believed that the desired range and accuracy could be accomplished with a single helicopter, and used both a multiple helicopter and single helicopter configuration in the early SOTAS testing.

The first SOTAS test was scheduled to be accomplished at Fort Ord. Very few in the Army expected the test to work, but it proved to be a huge success during the exercises. Even better from Kenneally's point of view, the single SOTAS helicopter provided almost identical accuracy and range as the two-helicopter approach.

Despite this success at Fort Ord, SOTAS did have some enemies. The Army Intelligence community owned the existing OV-1 Mohawk airplanes and saw SOTAS as a threat to their intelligence mission. The Artillery community had begun development of Remotely Piloted Vehicles (RPVs) to provide targeting support, and likewise saw SOTAS as a threat. In order to kill the SOTAS program, both the Artillery and Intelligence communities tried to gain control over SOTAS as a system that fell under their command.⁹ Norm Augustine and others within the Army R&D community were able to protect the program from these communities through the mid-1970s.

⁹ Bill Kenneally Interview.

In 1976, operational support for the program increased dramatically thanks to SOTAS' participation in Reforger 76.¹⁰ Usually, R&D systems don't participate in Reforger exercises, but through some personal ties with those involved in the exercise, SOTAS was approved to participate. Many people argued that SOTAS wouldn't be effective in Europe because the scale of the enemy forces is so much larger than that of SOTAS' previous exercises. However, SOTAS proved to be a huge success, providing early warning of attacks and identifying strategic troop movements. The SOTAS targeting data was also extremely easy to interpret by the ground operators. The targeting information was presented in such a way that previously uninitiated operators could recognize most target types after relatively little training. This was a great advantage over other surveillance systems of the day which required extensive training and analysis of data.

Once Reforger ended, the Army was convinced of the need for this system and pushed for the procurement of two "Interim Interim" SOTAS helicopters. These two new SOTAS helicopters were built within a year and, together with the two existing SOTAS helicopters, were permanently stationed in Germany for almost seven years.

The program had built a great amount of support within the Army by this time in 1976. The Army division commanders wanted to make the helicopter an organic part of the division that they could use to detect and track enemy troop movements in near-real time

¹⁰ Reforger, or Return of Forces to Germany, is a large-scale Army operational exercise in Germany to test the readiness and warfighting capabilities of the existing Army forces.

to support artillery fire at the targets. In the Reforger exercises, this operational concept had proven quite successful, and division commanders were very excited about having this battlefield surveillance asset under their control.

Air Force MTI Developments

In the early 1970s, the Air Force R&D community also began to gain interest in using MTI technology for ground surveillance. MTI technology had proven to be very successful for detecting moving airborne platforms, as demonstrated on the F-15 and AWACS aircraft, and some within the R&D community wanted to extend this MTI technology to ground surveillance. This effort began at Rome Air Development Center, primarily under the technical direction of John Entzminger, who had been successful at developing emitter-locating systems, but wanted to move into the area of locating non-emitting targets and providing near-real time intelligence on these targets to support tactical interdiction.

Entzminger began investigating these ideas through contracts with Lincoln Laboratories, and with the support of Harry Davis, the Assistant Secretary of the Air Force for R&D, put together a concept called Multi-Lateration Radar Surveillance and Strike System or MLRS3. The MLRS3 used precision range measurements from two aircraft to locate targets and to provide weapons guidance to attack those targets.

Entzminger put together a test program to demonstrate the MLRS3 concept at White Sands Missile Range in New Mexico. He had recently provided over a million dollars to the Army SOTAS program to help start its development, and took this opportunity to use the SOTAS helicopters to support the test. The two helicopters performed the multilateration function, and it worked quite well.

The real vision of John Entzminger was to locate non-emitting targets and provide near-real time targeting information to strike them. Following the test in 1975, Entzminger worked with Lincoln Labs to define a research program to refine a concept for using MTI on a fast-moving platform that would move the technology closer to his vision. A primary goal was to accomplish the mission with one aircraft instead of multiple aircraft, thus removing the complexity of the operation. The use of one aircraft would also reduce the response time from gathering targeting information to the assignment of strike forces, thus making the system more "real-time." The resulting program developed by Lincoln Labs was the Multiple Antenna Surveillance Radar or MASR. MASR was a high-precision, side-lobe, electronically-scanned radar, which accomplished the MTI mission on one airplane, and provided the necessary level of ground clutter cancellation needed for high speed aircraft. Lincoln Labs matured this antenna and in 1978 was able to demonstrate its effectiveness on a Twin Otter airplane tracking vehicles on several New England highways. This was sufficient as a "proof of concept" allowing the radar to progress into advanced development.¹¹

¹¹ Melvin Stone Interview.

One of the ideal characteristics of using electronically-scanned radar, like MASR, was that different radar modes could be interleaved using the same antenna. Lincoln Labs showed that the MASR could do both MTI and SAR surveillance, and allowed switching between modes. The potential of this capability excited Entzminger, who saw that MTI could identify moving targets within wide areas and SAR could provide the topographical context of the region, a detailed picture of the activity, and continuous tracking of targets that had become stationary. Entzminger continued to put money toward this project, which he called "Pod MTI Radar." This name was used because he wanted to put the radar in the pod of a tactical fighter aircraft, such as the F-4 or F-111.

Entzminger was interested in a configuration that would fit on a tactical fighter for good reason. Entzminger had been given strategic counseling from both General Creech (ESD Commander) and General Slay (AFSC Commander) that the platform must be TAC-oriented. General Slay was especially emphatic on this point -- he argued that an intelligence or SAC platform would not win the support necessary to keep the program alive. The intelligence community was not happy with Entzminger's efforts to tie what looked like a surveillance system to the command and control and strike community, but Entzminger knew that putting the radar on an intelligence plane would probably lead to early death: first, the intelligence community did not really know how to use a real-time surveillance technology like MTI, and second, another surveillance technology would not receive priority for funding within an already poor intelligence budget. Tactical Air Command had the funding necessary to develop and produce a system like this, and

besides, Entzminger's vision was that the system would be used real-time by battlefield commanders to direct attacks on targets.

Despite the focus on a tactical system, the radar development program was only able to secure about \$5 million per year, which was really not enough to get the program off the ground. In the tight budgets of the 1970's, TAC was not ready to put heavy financial support behind a new radar system they poorly understood.

This MASR effort led to a meeting regarding the Army and the Air Force MTI efforts. At the time, these two programs were independent, and Walter LaBerge (Assistant Secretary of the Air Force for R&D) and Norm Augustine (Assistant Secretary of the Army for R&D) met to discuss their future. The two assistant secretaries agreed that both these programs were needed and had different technological and operational requirements. Both programs were permitted to continue independent of one another, and very little interaction occurred between the two.

The early MTI developments of the Army and the Air Force were driven by the military R&D community with little initial interest from the operational communities. Both the Army and Air Force R&D communities saw the potential of this technology and developed operational ideas for how the system would be used: a division asset to support the artillery within the Army and a theater asset that would support tactical interdiction within the Air Force. By 1976, the Army system had gained wide support

within the Army while the Air Force system had not yet become widely known. Beginning in 1977, doctrinal and operational changes within the Army and Air Force would build a need for a near-real time surveillance capability that these systems, and especially the Air Force version, provided.

CHAPTER 3: OPERATIONAL DEVELOPMENTS

Beginning in 1977, the Air Force system gained some favor due to some doctrinal and technological shifts in the Army and in USDRE. In 1977, General Donn Starry became the new TRADOC Commander and brought to Army doctrine the consideration of the "extended battlefield." According to Starry, previous doctrine had focused too much on the battle with the front line troops, while not enough thought had gone into stopping the onrush of second and third waves of troops. These second and third echelons would need to be delayed, destroyed, or disrupted in order for the Army to win the battle. Affecting these deep forces would require air interdiction which was the traditional province of the Air Force. Starry called this new doctrine the AirLand Battle Doctrine.

Several factors characterized this emerging AirLand Battle Doctrine. The primary battle concept was one of maneuver and counterattack in which the corps commander would use different means to take the initiative against the enemy. The corps commander would have responsibility for the extended battlefield, out to 150km beyond the Forward Line of Troops (FLOT). The corps commander would rely on the use of powerful technology and the effective maneuver of his troops to gain the initiative against the enemy. This involved the use of "deep attack" weapons to disrupt and destroy second echelon forces. This doctrine also required an "integrated" battlefield where air interdiction was closely tied in with the ground war. In order to operate according to this doctrine, the Army and Air Force would require joint operations, near-real time battlefield awareness of the corps'

area of influence, and long-range radars and precision guided missiles to support deep attacks on moving targets. These all pointed to the requirement for a robust MTI capability beyond the early efforts by the Army and Air Force in the mid-1970s.

In addition to this emerging Army doctrine, NATO was also putting together a new doctrine known as Follow-On Forces Attack (FOFA). This concept relied on deep attack weapons to slow the generation of follow-on forces to allow NATO forces to win the engaged battle. The FOFA was different from AirLand Battle in that it relied on these deep attacks as part of its operational concept to win the battle. AirLand Battle did not count on deep attack, but rather used them as one tool to throw off the enemy timetable and provide a maneuver advantage. Whatever the differences, both NATO and the Army had undergone shifts in doctrine which emphasized the need for new “emerging technology” weapons and required a deep strike capability.

Under Secretary of Defense for Research and Engineering, Dr. William Perry, was a vigorous supporter of this deep strike approach, and its feasibility. A deep strike capability would require the integration of several emerging technologies in order to provide accurate deep attacks on moving targets. Dr. Perry gave DARPA the lead on the program which later became Assault Breaker. The concept for Assault Breaker was described by Jim Tegnalia, the DARPA Program Manager for the program:

“I have an airborne radar which surveys a geographical area of 200 square kilometers... The airborne radar is at 30,000 feet and is normally 50 kilometers behind the battle line to stay out of the range of enemy surface-to-air missiles. This radar would find and track targets, and the targeting data it gathered would be transmitted to a special ‘tactical fusion’

processing station. The station, 30 kilometers or more behind the battle line, also would receive intelligence from satellites, sensors, and other intelligence sources... After a decision had been made to attack specific targets, a missile would be fired and the radar would track both the missile and the targets, whether stationary or moving. The plane would issue mid-course guidance commands to the missile, which would have a range of 100 kilometers or more. Once the missile is in the vicinity of its targets, it would dispense its payload of 'smart' munitions that would key on the heat generated by enemy tanks' engines. The munitions would hit the top of the tank, its most vulnerable part."¹²

Between 1977 and 1982, these three developments, AirLand Battle Doctrine, Follow-On Forces Attack, and Assault Breaker, all echoed the need for a robust, airborne, long-range, MTI capability. John Entzminger would find a home for his radar development in supporting this deep strike technological effort.

Continuing Air Force MTI Efforts

As DARPA developed their concept for the Assault Breaker program, they looked to Rome Air Development Center and the radar work of John Entzminger as a possible source for the long-range radar to support the deep attack missile. Entzminger saw the Assault Breaker demonstration as an opportunity to continue his MASR development program, and agreed with DARPA to support the program. Assault Breaker brought with it both the addition of an extra \$5-10 million dollars a year for radar development and the opportunity to be involved in a "proof of concept" technology demonstration which could bring attention to the radar.¹³ However, there was a price to pay: the services did not

¹² "Highly Touted Assault Breaker Weapon Caught in Internal Pentagon Debate," *The National Journal*, Oct 22, 1983, Vol. 15, No. 43, p. 2152.

¹³ John Entzminger Interview.

look favorably on DARPA projects, and association with DARPA could cause difficulty in gaining Air Force operational support for the radar program later.

Despite the dislike of the Assault Breaker program by many within the Air Force, Entzminger and ESD Commander General Tom Marsh recognized it as the only existing opportunity to further the radar effort. These men were not as interested in the Assault Breaker concept as in the secure funding source the program provided. The vision of Entzminger and General Marsh (as well as General Creech, who was by then commander of TAC) remained that the radar would be used to support air-to-surface missiles and tactical aircraft guidance, not only Assault Breaker missiles.¹⁴ So a marriage of convenience was made: DARPA needed a radar to support the Assault Breaker program and RADC needed funding to carry forward the development of the MASR program. The MASR program was retitled "Pave Mover" to support the Assault Breaker program.

By late 1977, the configuration for the Assault Breaker demonstration had emerged. RADC would put a multi-mode SAR/MTI radar on a tactical aircraft with a datalink to send the radar data to a ground station for processing. The Army's Missile Research and Development Command (MIRADCOM) would provide the missile for the program, and White Sands Missile Range was chosen as the site for the demonstration.

RADC chose the F-111 fighter aircraft as the carrier for the radar. The F-111 was the tactical aircraft that Entzminger, General Marsh, and General Creech were looking for,

¹⁴ John Entzminger Interview.

and two F-111A models were available from the test wing at Eglin AFB. Entzminger believed the F-111 would be an ideal platform. In his concept of Pave Mover, the F-111 could accept an antenna large enough to do theater-level coverage, and all the data could be sent to the ground for processing. Perhaps more importantly, the F-111 was a tactical aircraft that would be more acceptable to TAC.¹⁵

In June 1979, ESD became more involved in the Pave Mover/Assault Breaker program and established a dedicated office in their Advanced Planning section. The office was headed by Lt. Col. Charles Jaglinski. The focus of the office was to come up to speed on the Pave Mover radar development in preparation for full scale development. (Typically, RADC manages basic and advanced research and then transitions programs to ESD for full scale development and procurement.) ESD's increased interest in the program was a sign that this radar was beginning to be taken seriously for full scale development; however, no specific operational concept had yet been developed for the system. At this point, the radar development was still very much a technology push effort driven by DoD civilian leadership and ESD advocacy rather than by the operational service's interests. As the program proceeded, a number of operational concepts began to develop.

One driving factor of new operational concepts was the fact that the F-111 platform for the radar began to lose favor in 1979-1980. First of all, the F-111 was very unreliable, especially the older F-111A models that were provided for the Assault Breaker exercise. The F-111 also provided a very low time on station (surveillance time) because it burned a

¹⁵ John Entzminger Interview.

lot of fuel very quickly.¹⁶ In addition to these concerns, TAC felt the bomber mission of the F-111 was a priority, and turning a number of these fighter-bombers into surveillance aircraft was not acceptable.¹⁷

Several alternative platforms and operational concepts began to emerge. One classified program supported by SAC and the requirements side of the Air Staff was to put the Pave Mover radar on a B-52 to support B-52 missions into "peripheral theaters." This strategic concept consisted of a B-52 with a Pave Mover radar and Assault Breaker missiles to provide a "self-contained detection and attack capability that can rapidly deploy to any location and operate with a minimum amount of external support."¹⁸ Many were convinced that giving the B-52 a conventional mission like this was necessary for the survival of the bomber force. The Air Force did, in fact, end up spending \$100-200 million in an effort to put Assault Breaker missiles on the B-52 before the program died in the early 1980s.¹⁹

The Air Force intelligence community began to look at integrating an MTI mode on its TR-1 Advanced SAR System (ASARS). ASARS was a high-resolution SAR used for reconnaissance missions on the TR-1 platform. Actually, this concept was not to add a Pave Mover radar to ASARS, but rather a Hughes-proposed enhancement of ASARS with its own MTI capability. This would have been a system with SAR as the primary

¹⁶ John Entzminger Interview.

¹⁷ Dr. Tegnalia Interview.

¹⁸ Memorandum for Record, "Platform Selection for Pave Mover System," Lt. Col. Charles Jaglinski, Director, Assault Breaker/Pave Mover System Program, ESD, Apr 16, 1981.

¹⁹ General Welch Interview.

mode and MTI as a secondary mode. Both Hughes and Lockheed advocated this approach, and they had a strong lobby in the Pentagon which kept this option alive. This lobbying group, headed by Hughes and Lockheed, and supported by contacts within the Pentagon, was known as the "SAR Mafia."²⁰

TAC also had its own version of an operational concept, which consisted of the Pave Mover radar and missiles on a C-130 aircraft. This also was a self-contained mission, but the C-130 could not easily be configured to house the missiles, radar, and on-board processing, and the C-130 could not fly at altitudes necessary to detect moving targets in hilly or mountainous terrain. This operational concept did not receive a lot of support.²¹

ESD favored a 707 platform to house both the theater surveillance radar and on-board processing that could provide airborne command and control. ESD felt this 707 option was good for quick deployment and autonomous operations when ground command and control was not available. ESD, and their MITRE support, were heavily involved in command and control system development for the Air Force, and saw this program as offering a very powerful and useful command and control role. ESD also believed this concept could support both TAC and SAC requirements by providing Air-to-Surface Missile guidance for SAC and for guiding tactical fighter aircraft to targets for TAC.

²⁰ John Entzminger Interview.

²¹ Memorandum for Record, "Platform Selection for Pave Mover System," Lt. Col. Charles Jaglinski, Director, Assault Breaker/Pave Mover System Program, ESD, Apr 16, 1981.

These operational concepts, along with a few other classified ones, floated around the Air Force throughout 1979 and 1980, with position papers, technical studies, and various other activities supporting one or the other. By early 1981, the 707 concept began to gain favor. General Jasper Welch, Assistant Deputy Chief of Staff for Research, Development, and Acquisition, became a strong advocate within the Air Staff for the 707. He advocated that the 707 had the range and size to support the SAC B-52 mission by accompanying an armada of B-52s into a peripheral theater and providing the target location, missile guidance, and command and control necessary to accomplish the contingency mission. ESD Commanders General Marsh and later General Stansberry had also begun to convince General Creech (now TAC Commander) that the 707 could provide "Direct Attack" support, guiding a tactical fighter to a target.

By the summer of 1981, General Welch was able to gain the support of the Air Force Council, consisting of all the Air Staff three-star generals and the Vice Chief of Staff. Welch brought together the Council to formally address the platform issue and to accept the 707.²² The Air Force had decided to support the MTI program for purely Air Force strategic and tactical interdiction missions, with little thought of joint operations like AirLand Battle and Assault Breaker. (It should be noted that even these missions were only marginally supported by TAC and SAC, who were primarily interested in acquisitions of their existing and next generation systems -- fighters, bombers, and missiles.) By early 1982, ESD began putting together a Request for Proposal for full scale development of Pave Mover on the 707, called the Pave Mover Engagement System.

²² General Welch Interview.

Continuing Army MTI Efforts

In 1977, the Army decided to initiate a full scale development program for SOTAS. The RFP developed by the Army called for SOTAS to be integrated onto a UH-60 Blackhawk helicopter and to take advantage of recent technological advancements that would make the radar system more capable.

The contract was awarded to Motorola and Lockheed in July 1979. Everyone was surprised that General Dynamics, with their long involvement in the SOTAS program, did not win the contract. There was also a great deal of surprise at how low Motorola, who had previously very little experience in the role of system integrator, had bid for the full scale development contract: about \$60M versus the Army internal estimate of \$90M.

Within 2-3 days after contract award, the program that had come so far over the past five years quickly began to fall apart. The problems started as both the Army and Motorola replaced key participants in the program. Motorola replaced the lead engineer who had directed most of the proposal preparation and the Army replaced the program manager and lost the technical services of Bill Kenneally (who left to attend Army War College). Both sides brought in inexperienced program managers and new technical directors to manage the acquisition.

This left both the contractor and government teams with severe technology management handicaps, and it did not take long for these handicaps to cause significant problems in the program. By August of 1980, Colonel Davis, the new Army Program Manager, reported that the program had serious problems: cost overruns, technological challenges, management problems, and producibility issues.

The Army's Materiel Development and Readiness Command (DARCOM) directed the formation of a Blue Ribbon Committee to conduct an "independent review of the program to determine how it could be placed back on track."²³ After analyzing the SOTAS program, the Committee reported that the program could recover, but Motorola must get a handle on the costs of the program and on their role as system integrator, and the Army must do a better job of contract oversight.²⁴ The Army and Motorola spent the next few months trying to come to an agreement on how to restructure the effort and continue the project. The result was an Army proposal in May 1981 to restructure the acquisition program in a way that extended the program by 33 months, reduced the planned procurement quantities by about one-third, and nearly doubled the costs in constant dollars, not including inflation. This was unacceptable to OSD.

OSD replied to the restructure with some stinging remarks. OSD replied that the "growth in cost...is taken as evidence of unacceptably poor management and lack of program

²³ Memorandum, "Report of the SOTAS Blue Ribbon Committee," Dr. Haley, Chairman, SOTAS Blue Ribbon Committee to Commander, HQ DARCOM, Nov 28, 1980,.

²⁴ Memorandum, "Report of the SOTAS Blue Ribbon Committee," Dr. Haley, Chairman, SOTAS Blue Ribbon Committee to Commander, HQ DARCOM, Nov 28, 1980.

control...The Services must ferret out and promptly correct any instances of inefficiency, incompetency, mismanagement, or misrepresentations of program implications. Simply sending more money to a troubled program will not be accepted. Contractors who contribute to our problems will not be rewarded.” OSD directed the Army to prepare new SOTAS program requirements that accelerated fielding, reduced costs, assessed alternative radars, and proposed options to remove the system integration role from Motorola.²⁵

The Army sought to develop a low-cost solution to the development problems. They examined different potential radars, including Pave Mover, and proposed to Motorola to turn the contract from a Cost Plus Fixed Fee (where Motorola was reimbursed for all costs plus a profit margin) to a Fixed Price contract (where Motorola would have to accept a set price for the remainder of the contract).²⁶ In the end, no acceptable solution could be reached between the Army, OSD, and Motorola. Congress canceled the program in December 1981.

Despite the cancellation, the Army Materiel Command still wanted to keep the technology alive, and so the system was given a different name, the Battlefield Data System. The same program office in the Army’s Electronics Research and Development Command (ERADCOM) handled this effort. The Army still wanted to obtain this capability to

²⁵ Memorandum, “Stand-Off Target Acquisition System (SOTAS) Decision Memorandum,” Jun 1, 1981, OSD to Secretaries of the Army and Air Force.

²⁶ Bill Kenneally Interview.

provide near-real time battlefield surveillance support for the division and corps commanders, and ERADCOM started investigating ways to bring this project back to life.

By 1981, the Army and Air Force had furthered their development of individual system design, requirements, and operational concepts. Very little interaction had occurred between the two programs, and they were both prepared to move forward. In addition, the emerging AirLand Battle Doctrine and the DARPA Assault Breaker program had provided an operational requirement for an MTI system like Pave Mover, but in a joint context rather than the independent context the services wanted.

CHAPTER 4: IMPOSING JOINTNESS: FIRST ATTEMPT

The Army and Air Force programs had both started with the technology push of the military R&D communities and proceeded through development independent of one another, with little reason or desire for collaboration. The doctrinal and operational concept changes in the late 1970s and early 1980s had given rise to the need for systems like SOTAS and Pave Mover. However, the doctrinal changes also called for an 'integrated' battlefield, which these two systems and the services were not prepared to provide.

In May 1980, USDRE showed its first sign of concern that these two expensive MTI programs were moving ahead with very little interaction. The Principal Deputy USDRE, Walter LaBerge, sent a letter to the Assistant Secretaries for R&D of the Army and Air Force noting that the two programs "so far have had no interrelationship, neither recognizing the existence of the other." LaBerge asked them to study the interrelationship of SOTAS and Pave Mover and to identify whether the huge investment into both systems was warranted.²⁷

The Assistant Secretaries of the services replied in October 1980 that the two programs "have cooperated as development progressed," and that these systems were envisioned to be complementary, "with SOTAS intended as an Army division asset and Pave Mover as a

²⁷Memorandum, "SOTAS and Pave Mover," Walter B. LaBerge, PDUSDRE, to Dr. Pierre, ASA(RDA), and Dr. Hermann, ASAF(RDL), May 28, 1980.

theater asset." The memo went on to say that TAC, SAC, and TRADOC would prepare a more complete answer to the USDRE concerns.²⁸ Despite these statements, the two programs lacked clear operational differentiation which made the programs a prime target for consolidation and jointness mandated by USDRE.

In October 1980, the two Service Staffs sent out a message to TAC, SAC, and TRADOC requesting that they put together a joint study team to look at the operational and technical interrelationship of SOTAS and Pave Mover and to clearly identify their differences.²⁹ The Service Staffs viewed most of the concerns of LaBerge to be of an operational nature, and felt this was best handled by the operational community. HQ TAC replied in November that they were "neither manned nor technically equipped" to do the analysis, but "stand ready to contribute operations perspective to the study but not to take the lead."³⁰ TRADOC followed shortly after with a similar reply.³¹ Although new joint doctrines and operational concepts requiring real-time battlefield surveillance were talked about, the actual mechanics of how these concepts would be implemented was far from complete. The services had definitely not come to terms with the operational differentiation or the interoperability requirements of the two systems.

²⁸Memorandum, "SOTAS and Pave Mover," Dr. Hermann, ASAF(RDL), to PDUSDRE and ASD(C3I), Oct 30, 1980.

²⁹Message, "SOTAS and Pave Mover," HQ USAF//RDP/XOO/XOX and HQ DA/DAMA-CS to HQ TAC//XP/DR/II/DO and CDR TRADOC//ATCD/ATCD-IS-R, Oct 30, 1980.

³⁰Message, "SOTAS and Pave Mover," HQ TAC/XP to HQ USAF//RDP/XOO/XOX, Nov 17, 1980.

³¹Memorandum, "SOTAS and Pave Mover," HQ USAF/RDPV to Maj Gen Marshall, HQ USAF/RDP, Jan 28, 1981.

In June 1981, John Entzminger was completing his role on the fact-finding team of the SOTAS Blue Ribbon Commission when he wrote an urgent letter to Lt. Col. Jaglinski, the Pave Mover program manager. Entzminger emphatically called ESD to develop complementary and interoperability plans for the Pave Mover and SOTAS systems:

“Both OSD and Congress see SOTAS and Pave Mover as competitive systems. Both services stress the complementary nature, but to be complementary, a significant number of interfaces must be addressed. Words will no longer suffice with Congress, they want to see hard plans. It is imperative that you immediately establish an Interoperability Working Group with the SOTAS program office...”³²

In July 1981, USDRE called for the Army and Air Force, with Army as lead service, “to define the concepts of operation, to identify the optimum mix of systems,...and to establish a mechanism which will ensure that the systems will properly interoperate.”³³ This once again pointed to the poor job the services had done of developing operational concepts (with the operational community buy-in) and interoperability requirements. Both Congress and OSD would require a satisfactory response to these questions before authorizing any additional funding for the SOTAS program. Congress and OSD did not receive a satisfactory response, and the SOTAS program was canceled in December 1981.

³²Memorandum, “SOTAS Lessons,” John Entzminger, Jr., Technical Director, Intel and Recon Division, RADC, to Lt Col Jaglinski, ESD/XRT, Jun 24, 1981.

³³Memorandum, “Interoperability of Airborne Reconnaissance, Surveillance, and Target Acquisition Radars,” Jim P. Wade, PDUSDRE, to ASA(RDA) and ASAF(RDL), Jul 31, 1981.

USDRE Mandates the Joint Program

The cancellation of SOTAS gave USDRE an even greater justification for considering a joint effort between the services to meet their MTI needs. In January 1982, USDRE decided to set up a task force to look at this issue "to avoid duplications of effort and to chart a cohesive rational program" for the acquisition of MTI surveillance/target acquisition systems.³⁴ USDRE Richard DeLauer sent a letter to the services to set up the Reconnaissance, Surveillance, and Target Acquisition (RSTA) task force. The letter called for USDRE representatives to head the Task Force with the participation of two senior individuals from each service and from DARPA. The task force was given the mission of providing USDRE with a list of prioritized programmatic alternatives for an MTI system that sought optimum commonality in the radar, data link, and ground station subsystems.³⁵ DeLauer had been amazed to see six or seven different ground surveillance radars all in development consuming hundreds of millions of DoD dollars, and he was convinced that a joint program was best.³⁶

DeLauer also directed that the effort be completed quickly. Apparently this was driven by an upcoming HASC meeting in early April which would determine the future of the FY83 budget for the Army Battlefield Data System (the remains of SOTAS). USDRE wanted to keep that money in the budget to support the new joint program, and felt they needed to put together an executable program quickly in order to salvage the funds.

³⁴Memorandum, "Battlefield Reconnaissance, Surveillance and Target Acquisition (RSTA)," Richard C. DeLauer, USDRE, to Secretaries of the Army, Navy, Air Force, and Director, DARPA, Jan 11, 1982.

³⁵Memorandum, "Battlefield Reconnaissance, Surveillance and Target Acquisition (RSTA)," Richard C. DeLauer, USDRE, to Secretaries of the Army, Navy, Air Force, and Director, DARPA, Jan 11, 1982.

³⁶John Entzminger Interview.

By early March the recommendations were under review and hotly contested by a number of people. The Task Force had concluded that the services should pursue a single, multi-mode (MTI, SAR, FTI, Weapons Guidance) core radar with modular elements for use on both the Army OV-1 and the Air Force TR-1. The recommendations called for all the data processing to be done on the ground, and that a limited number of 707 platforms could be built as an airborne backup to the ground stations.³⁷ The Task Force had concluded that the Army and Air Force MTI requirements were "sufficiently similar" to develop a common core radar for both services. The Task Force reported that they chose the TR-1 based on its high grazing angles (the TR-1 flew at high altitudes and could better see over mountains and buildings), and the OV-1 based on its strong support by the Army as a second primary platform.³⁸

Despite some strong opposition within the services, Principal Deputy USDRE Jim Wade issued a mandate for the joint program in May 1982. His rationale was that central management and control in a joint program office was necessary to ensure steady and adequate funding, as well as fully interoperable and complementary systems. The memo again identified the TR-1 and OV-1 as the platforms and named the Air Force as the lead

³⁷Memorandum, "Battlefield Reconnaissance, Surveillance and Target Acquisition (RSTA) Task Force," AF/RDP to AFSC/XR, Apr 16, 1982.

³⁸Memorandum, "Battlefield Reconnaissance, Surveillance and Target Acquisition (RSTA) Task Force," AF/RDP to AFSC/XR, Apr 16, 1982.

service because "the Army is not yet convinced it needs a multi-mode radar." Wade also called for the termination of all other low-velocity MTI radar development efforts.³⁹

USDRE had imposed jointness, forcing the creation of a joint program office and the cessation of all independent service MTI efforts. This was the beginning of a two year struggle over requirements, control, and funding between several different groups that had a stake in this MTI technology.

In order to understand the actions that occurred between May 1982 and May 1984, it is first useful to look at the interests of the different players involved. Brigadier General Dave Herrelko said his quote of this period was, "Hardware is moving at the speed of light; Software is proceeding at the speed of sound; the system is evolving at the speed of *human consensus*."⁴⁰ The services, Congress, and OSD all had specific interests in the MTI technology which would complicate and slow down the joint system development process.

Congress, especially the HASC, was interested in applying the MTI technology to their favored stealth applications, as well as to the Assault Breaker program. Congress also strongly supported the concept of joint system development programs as a way to save money. OSD had mixed feelings about the joint MTI program. Some within OSD felt the technology was not mature and that the system as employed in the Assault Breaker

³⁹Memorandum, "Battlefield Reconnaissance, Surveillance and Target Acquisition (RSTA)," Jim Wade, PDUSDRE, to Secretaries of Army, Navy, Air Force, and Director, DARPA, May 19, 1982.

⁴⁰ General Herrelko Interview.

program was not really operationally effective. *USDRE* had two primary interests: to protect their Assault Breaker program and to fulfill their role in reducing duplicity of weapons development. The joint program satisfied both of these goals. The *intelligence community* was split in their desire to control the MTI technology, with the OSD and Congressional leadership in support of the use of MTI on the TR-1 and the operators more concerned with autonomy from the battlefield commanders who would want the real-time surveillance data.

The Air Force and Army had different MTI priorities: the Air Force wanted a theater surveillance system with airborne command and control, and the Army wanted an organic, division-owned, MTI-only capability. Neither service was very fond of the attempt to put the radar on intelligence platforms, nor were the services supportive of the DARPA-managed, high-technology Assault Breaker program. To the services, the Assault Breaker program was a conflict of existing Army and Air Force roles and missions, was not a mature or operationally proven technology, and had started in DARPA, home of reject programs.

Both radar commonality and the Assault Breaker programs were initiatives of OSD, and as Jim Tegnalia reported in 1984, "such initiatives are never popular with the services."⁴¹ A similar comment regarding the radar commonality was issued by an arms expert from one of Washington's think-tanks, "It was a brave plan like all of these joint efforts

⁴¹ "Antitank Testing Unrealistic, Some Officials Say," *The New York Times*, May 22, 1984, Late City Final Edition, Sect. A, p. 21, Column 1; National Desk.

mandated by OSD, but it was politically naive. As we saw when McNamara tried to get the Navy to adopt the F-111, it's just not realistic to think that commonality, because it seems rational, should be assigned a high priority by the individual services."⁴²

Each party had different interests involving doctrine, operational concepts, technological requirements, and organizational issues, and many were in direct conflict. These conflicting interests would make it very difficult and time-consuming to resolve joint requirements. Each party would work to insure its interests were included in the final system configuration.

Joint System Development Efforts and Difficulties

After the decision to place the program under Air Force leadership, ERADCOM refused to co-locate the Army developers at Hanscom AFB. General Paige, commander of ERADCOM, decided to keep the development team at Fort Monmouth, NJ, and instead sent only the new Deputy Program Director for Joint STARS, Colonel Alex Johnson, to Hanscom. Johnson was involved in the original development of the SOTAS concept and was an ardent supporter of an autonomous Army development program.⁴³ The second decision by General Paige was to hold very tightly to "Army requirements" that he knew would not be acceptable to the Air Force. He hoped these efforts would encourage the break up of the joint program.⁴⁴

⁴² "Heavy Going for Deep Strike," *Aerospace America*, Feb 84, p. 10.

⁴³ Charles Jaglinski Interview.

⁴⁴ G. Sidney Smith Interview.

Within the Air Force, General Stansberry (ESD Commander) and Lt. Col. Jaglinski, the System Program Director, spent a lot of time trying to move the Air Force platform away from the TR-1 and to build support for their TAC-oriented, large platform approach. ESD firmly believed that the large platform was operationally best and sought to build support for this program. ESD spent time in 1982 meeting with TAC to try to gain support for the Direct Attack mission from the F-15 and F-16 community.⁴⁵ They worked with MITRE to begin writing some draft requirements and system specifications, hoping to get TAC to agree to them.

By early 1983, it looked like ESD's large platform salesmanship had paid off. In late 1982, Jaglinski had received the support of the 9th Air Force and Rapid Deployment Joint Task Force Commanders for the 707 platform.⁴⁶ In January 1983, Jaglinski traveled to Washington and briefed the Air Force Force Structure Panel, the TAC Panel, the Reconnaissance and Intelligence Panel, the Program Review Committee, the Air Staff, and the Principal Deputy of USDRE (Jim Wade) on the platform choices. When he returned from this Washington trip, he believed he had received the go ahead to use the 707 platform for the Air Force and prepared to remove the TR-1 references from the draft specifications and requirements.⁴⁷

⁴⁵ Memorandum, "TCG Monthly Activity Report for November 1982," Joseph R. Russo, Acting Director, Joint STARS Program, Deputy for Tactical Systems.

⁴⁶ Memorandum, "TCG Monthly Activity Report for October 1982," Joseph Russo, Acting Director, Joint STARS Program, Deputy for Tactical Systems.

⁴⁷ Memorandum, "TCG Monthly Activity Report for January 1983," Lt. Col. Jaglinski, Director, Joint STARS Program, Deputy for Tactical Systems.

However, this victory lasted only a short time. In May 1983, word came down that Congress may prohibit the use of the 707 platform in the Defense Authorization language. The Program Office was put on notice to be prepared to put the TR-1 language back in to the system specifications if necessary.⁴⁸ It appears Tony Battista, a member of the HASC Staff, had a strong hand in this because he did not want Boeing to win this contract and he wanted the radar to be small enough to support his favored stealth projects. General Herrelko even mentioned that during this time Battista came storming into his office with his copy of the draft system specification. Battista pointed to two changes he wanted to make in the specification: do not let the 707 be modified to accept the radar and ensure the radar is below certain weight and size limitations. In the final debates over the FY84 Defense Authorization, the language adopted by Congress directed the use of the TR-1 platform and permitted a demonstration (or test) version only of Joint STARS on the 707.

The Intelligence community also added their support to the TR-1 platform. Lockheed prepared an unsolicited proposal for a TR-1 Joint STARS prototype,⁴⁹ and both Lockheed and Hughes continued to lobby for adding a Joint STARS-like capability as a secondary mode on the ASARS. To combat this, ESD and MITRE put together detailed analyses to show that the Joint STARS requirements were not achievable on the TR-1 due to size and weight limitations that reduced the radar power.

⁴⁸ Message, "Joint STARS Full Scale Development (FSD)," HQ USAF/RDPV to HQ AFSC/XR, ESD/TCG, and HQ TAC/SMO-PLS, May 4, 1983.

⁴⁹ Letter, "Proposal for Installation and Flight Test of Grumman/Norden Pave Mover System in a TR-1 Aircraft," Ben R. Rich, Vice President and General Manager, Advanced Development Projects, Lockheed-California Company to Mr. D. C. Latham, Deputy Under Secretary (C3I), OSD, Apr 19, 1983.

By early 1983, the Army and Air Force had come to very few agreements on requirements. Both General Paige and General Stansberry agreed to bring in new program directors that had less of a history in the program. Both Jaglinski and Johnson had too much of a legacy at stake (and too many enemies within the other service), so they were moved on. In March 1983, Colonel Jay Hailey came in as the Air Force System Program Director and Lt. Col. G. Sidney Smith came in to replace Johnson as the Deputy System Program Director. Neither of these men had a strong past with the Joint STARS system or its predecessors, so it was hoped that they would be much more objective. This was indeed the case, especially of Smith who took more interest in the successful development of the joint program than of the political agenda of the Army.

By the summer of 1983, still no resolution had occurred between the Army and the Air Force on Joint STARS requirements. OSD had directed an IOC of 1987 for the Army MTI system and that date was in danger of slipping because of the lack of progress. Money that had been programmed for 1984 was also in jeopardy because the lack of progress toward contract award would make it impossible to spend these funds within the year. Also, the potential contractors were investing huge amounts of money to stay in the game and could not "continue to keep proposal-writing teams on 'red alert'" for much longer.⁵⁰ In order to resolve the issue, a General Officer Joint STARS Requirements Review Panel was scheduled for September 1983. The panel was co-chaired by generals

⁵⁰ "Point Paper on Joint STARS Full Scale Development Request for Proposals (RFP) – Status," Maj Herrelko, AF/RDPV, Sep 29, 1983.

from TAC and TRADOC. The following rationale was given for the convening of the panel:

“The normal joint program processes are incapable of meeting the directed Army IOC, consequently extraordinary measures are required to accelerate requirements definition and identify associated technical specifications required to begin the joint radar development.”⁵¹

In other words, the process of joint system development was getting nowhere and this review hoped to start the program moving forward. The generals hoped to make decisions during this review that would define the necessary joint requirements to move into full scale development.

The Review focused on three controversial requirements and on the acquisition strategy for the radar. The services' view on these items tied closely to their individual interests: the Army was concerned with cost, schedule, and autonomy, and the Air Force was concerned with their minimum performance requirements. The three requirements were 1) the need for SAR, 2) open loop vs. closed loop weapons guidance, and 3) antenna scan angle. These three debates were brought to the table primarily by General Paige, who again tried to move toward the lowest cost and most SOTAS-like system to meet the Army's needs. The acquisition strategy debate focused on whether to develop a single radar to meet all requirements or to build two separate Army and Air Force antennas.

⁵¹ Memorandum, “Joint Requirements for Joint Surveillance and Target Attack Radar System (Joint STARS),” Maj. Gen. Craig, DCS, Requirements, HQ TAC, and Brig. Gen. Hammond, Asst. DCS for Combat Developments, HQ TRADOC, to Maj. Gen. Gorton, HQ USAF/RDQ, and Maj. Gen. Wagner, HQ DA/DAMA-FD, Sep 29, 1983.

First, the Army argued they had no need for SAR. They argued that real-time SAR has little chance of operating successfully in battlefield clutter, and that the value of SAR was marginal since random stopping of engaged targets was considered an infrequent event. The Air Force countered that SAR had proven to be successful in both the ASARS program and in the Pave Mover tests at White Sands Missile Range. The Air Force also held that SAR was a minimum requirement for the successful engagement of targets that have dropped beneath the MTI minimum detectable velocity.

Second, the Army argued that they wanted an open loop rather than closed loop weapons guidance mode. In the Army concept of open loop, Joint STARS would track only the target and provide position updates to the missile. In closed loop guidance, Joint STARS would track both the target and the missile, and give the missile position updates relative to the missile's location. Open loop used absolute coordinates which were only as good as Joint STARS' internal navigation coordinates, while closed loop used relative coordinates which lessened the error. According to Herrelko, the open-loop guidance accuracies were "technically bankrupt for missile guidance more than 30km beyond the (Forward Line of Troops) FLOT."⁵² (This 30km range is the range the Army was primarily interested in anyway.)

Third, the Army wanted a more narrow antenna scan angle than the Air Force. The narrow scan angle met the Army's requirements and was a simpler development, which

⁵² Memorandum, "Joint Requirements for Joint STARS," Maj Dave Herrelko, AF/RDPV to AF/RDP, Oct 4, 1983.

they argued better fit the development schedule to meet the Army IOC. The Air Force argued from technical analysis that the wider scan angle was not a high-risk development, and that without the wider angle they could not perform complete, continuous coverage of the corps-sized battlefield.

Outside these requirements, the Army also defended their choice of a data link for the system. Four data links were being considered: a link developed under the SOTAS program called the Modular Integrated Communication and Navigation System (MICNS) link; a backup to MICNS later called SCDL; a link developed out of ESD called JTIDS; and finally, a link used by the intelligence community on the TR-1 called the Interoperability Data Link (IDL). General Paige was adamant about using MICNS. He argued that the Army had competed MICNS "fair and square" for SOTAS and that "we are not prepared to discard MICNS."⁵³ Of course, ESD wanted their own JTIDS link and the intelligence community pressed for the IDL. There were also Congressional inquiries coming in about competition of the links which Herrelko attributed to the effectiveness of Sperry's and Cubic's lobbying on the Hill.⁵⁴ (In addition, TAC demanded anti-jam voice links: they supported the JTIDS requirement of ESD, but still culturally were not ready to rely on pure data tracks alone.⁵⁵)

To meet these requirements differences, the Army proposed that the acquisition be structured to develop two separate radar antennas. The first radar antenna should be

⁵³ "Point Paper on Joint STARS Data Links," Maj Herrelko, AF/RDPV, Sep 29, 1983.

⁵⁴ "Point Paper on Joint STARS Data Links," Maj Herrelko, AF/RDPV, Sep 29, 1983.

⁵⁵ General Stansberry Interview.

developed for the OV-1 in a low risk conservative approach to meet the early Army IOC with the simpler MTI-only mode, narrow scan angle, and open loop weapons guidance. (Very similar to SOTAS!) The contractor should then develop the full multi-mode capability with closed-loop guidance and wider scan angle for the 707/TR-1. The fully capable radar could then be retrofit onto the Army OV-1.

In the opinion of Herrelko and General Stansberry, the Review had been dominated by the agenda of the Army. General Stansberry argued that the "apparent focus was on the three heartburns identified by Major General Paige." He went on to say that the "Army apparently has locked-on to every subsystem they need for a SOTAS-like system."⁵⁶ Herrelko also complained that TAC hadn't thought through their requirements. He said, "TAC's requirements briefing was really: 'How we'll use what ESD builds.'"⁵⁷

Of even more concern to ESD was the acquisition strategy that was proposed. The proposed strategy had the Army paying for their simple antenna and the Air Force paying for a separate antenna and all the multi-mode work. Herrelko complained that this strategy eroded the authority of the Air Force as the lead service, which had already been weakened by the "long-standing Army SOTAS affiliations and Army insistence on keeping the bulk of Army JPO people at Fort Monmouth."⁵⁸ Herrelko followed this with a

⁵⁶ Memorandum, "Joint STARS (ESD/CC Reaction to TAC/TRADOC Requirements Results)," Maj Dave Herrelko, AF/RDPV, to AF/RDP, Sep 30, 1983.

⁵⁷ Memorandum, "Joint Requirements for Joint STARS," Maj Herrelko, AF/RDPV, to AF/RDP, Oct 4, 1983.

⁵⁸ Memorandum, "Joint Requirements for Joint STARS," Maj Herrelko, AF/RDPV, to AF/RDP, Oct 4, 1983.

warning: "Army appears to have every piece of the puzzle for an austere SOTAS/BDS system, except the antenna. I bet Army will bolt the program as soon as they have delivery on their minimum-capability antenna, leaving the Air Force holding the bag."⁵⁹

In the end, the Review Panel agreed to let the Army begin early development for their OV-1 Joint STARS radar, while the Air Force developed a 707 testbed to mature the weapons guidance, SAR, and wider scan angle capabilities. The Panel decided that the OV-1 should start with these simpler requirements, and if the 707 testbed proved the maturity of the Air Force requirements, they would be added in to the final production configuration of the OV-1 system.⁶⁰

In March 1984, without much resolution on the requirements, a very 'unjoint' Request for Proposal (RFP) was released to the potential contractors. The RFP called for three platforms: the OV-1, the TR-1, and the 707. The radar development was to occur in three phases. The first phase was to develop the simpler MTI-only radar for the OV-1 to support the early Army IOC. The second phase was to improve the OV-1 radar by adding SAR and allowing uplinks from ground stations on the SCDL. The third phase was to build the full Air Force-configured radar system with MTI, SAR, and closed loop weapon guidance to go on the 707, TR-1, and OV-1 platforms.

⁵⁹ Memorandum, "Joint Requirements for Joint STARS," Maj Herrelko, AF/RDPV, to AF/RDP, Oct 4, 1983.

⁶⁰ Memorandum, "Joint Requirements for Joint Surveillance and Target Attack Radar System (Joint STARS)," Maj. Gen. Craig, DCS, Requirements, HQ TAC, and Brig. Gen. Hammond, Asst. DCS for Combat Developments, HQ TRADOC, to Maj. Gen. Gorton, HQ USAF/RDQ, and Maj. Gen. Wagner, HQ DA/DAMA-FD, Sep 29, 1983.

This RFP was huge in scope, would be very expensive to complete, and was extremely difficult for a contractor to bid on. The RFP was released, however, and the contractors did attempt to put together proposals. Despite USDRE's attempt to force the joint development program, the services had managed to issue a request for completely separate individual service systems. The Army's system looked very much like SOTAS, the Air Force system looked very much like Pave Mover, and now a third platform was added that looked very much like an intelligence system. USDRE's efforts had failed to bring about successful joint system development.

After seeing these developments, the HASC was fed up with the lack of service cooperation and issued a report about Joint STARS claiming that "the 'joint' program was such in only a rhetorical and not a substantive sense." In commenting on the different platforms, the report said that "all prospects for a common radar were lost," and recommended giving all the funds for Joint STARS development to the Army.⁶¹

USDRE's efforts to impose jointness on the MTI development were not able to overcome the differences in service requirements, and the Army's new doctrine, while advocating joint operations, was far from being feasible to implement. Congress and OSD, the biggest fans of jointness, were frustrated by the lack of progress by the services. The

⁶¹ "Hope for a Joint Missile Abandoned by Pentagon," *The Washington Post*, Final Edition, May 17, 1984, First Section, World News, p. A36.

“jointness” imposed by USDRE had already cost two years of time with no progress on joint MTI requirements.

CHAPTER 5: IMPOSING JOINTNESS: SECOND ATTEMPT

By late 1983, the survival of the Joint STARS program was in serious jeopardy. Congress and OSD were angry about the lack of cooperation and jointness on the project, the money was in danger of disappearing, and the support of the service operational communities was beginning to wane. It was at this point that the Chiefs of Staff of the Air Force and Army stepped in.

In the summer of 1983, the Chiefs had to justify their individual conventional forces programs before the Defense Review Board (DoD's highest level of program and budget review). It had become clear that the public, Congress, and the DoD wanted the services to cooperate more fully and avoid wasteful duplication, and during this review the Chiefs underwent tough questioning. This experience impressed on the Chiefs the need to identify and support some form of joint effort in order to answer OSD and Congressional concerns. In the summer of 1983, the Chiefs decided to initiate a process of the "joint force development of the most effective, affordable forces required for AirLand combat operations."⁶²

The Deputy Chiefs of Staff for Operations and Plans (OPSDEPs) were given the responsibility to begin the joint force development process. These men appointed two colonels to draw up the Terms of Reference to guide the process of initiating the joint development of AirLand combat forces. These two colonels worked with the OPSDEPs

⁶² Davis, Richard G., *The 31 Initiatives: A Study in Air Force - Army Cooperation*, Office of Air Force History, Washington, DC, 1987.

on this effort and in November 1983, the colonels brought the Terms of Reference before General Gabriel and General Wickham, the Air Force and Army Chiefs of Staff. The Chiefs approved of the terms and signed a Memorandum of Understanding entitled, "Initiation of a Joint US Army - US Air Force Development Process," which became the foundation for the joint force development effort.⁶³

The Terms of Reference called for the establishment of a Joint Force Development Group (JFDG) whose goal would be to identify systems needed to meet the AirLand Battle missions and to analyze how these systems can be integrated with currently existing and planned military systems. In November 1983, the OPSDEPs put together the JFDG. The group consisted of 12 members, mostly lieutenant colonels and majors, who were hand-picked because of their experience in joint environments and their orientation toward tactical warfare.

The JFDG deliberated from November 1983 through March 1984 over the joint forces needed to support the integrated AirLand Battle. In March 1984, the group presented their recommended initiatives to the Army and Air Force Chiefs of Staff. In April 1984, the Chief approved 31 of the 32 initiatives recommended by the group (only dropping the fusion of Army and Air Force tactical intelligence on the battlefield because this was too complex or too sensitive for the battlefield environment).

⁶³ Davis, Richard G., *The 31 Initiatives: A Study in Air Force - Army Cooperation*, Office of Air Force History, Washington, DC, 1987.

Interestingly, the initiatives did not really drive the services to joint system development or joint operations, but really identified ways to keep the Army and Air Force missions divided and to coordinate the separate service missions rather than integrate them. One initiative, for example, called for all rotary wing airlift support of Special Operations Forces to be transferred to the Army in order to move the Air Force away from owning helicopter assets. Another initiative refocused the Army missile development efforts onto shorter range systems and gave the Air Force more freedom to investigate air-launched missiles. One initiative reaffirmed the Air Force mission of providing fixed-wing Close Air Support to the Army. These were all affirmations and directions to further traditional service missions and boundaries. The initiatives allowed the services to answer OSD and Congressional concerns while still operating along traditional service lines.

One of these 31 initiatives called for the Joint STARS system to go on a single Boeing 707 platform to support both the Air Force and the Army. The initiative also required the services to "outline procedures to ensure dedicated support of ground commander requirements." The choice of the 707 platform fit the overall strategic objectives of the joint initiatives to keep Army and Air Force traditional missions separate. Removing the OV-1 requirement fulfilled an objective to move the Army away from fixed-wing aircraft. The Chiefs also agreed to "eliminate duplication in manned tactical reconnaissance by pledging that when joint requirements can be met by a single service platform, that service will assume single-service mission (not joint!) and the development lead."⁶⁴ The 707 was the logical choice for the single platform, especially since the Air Force had already been

⁶⁴ "USAF, Army Agree on Joint Initiatives," *Aviation Week and Space Technology*, May 28, 1984.

chosen as the development lead. Finally, in order to coordinate Army and Air Force missions with the system, the initiatives designated that procedures be set up to insure the ground commanders get the dedicated support of the radar system. The Army also had other funding priorities so that the idea of paying for another SOTAS-like system only had modest support within the service by 1984. The Army was also promised the acquisition management of the ground station, which gave them control over the Army portion of the command and control program.

The 707 platform decision was a compromise that those inside and outside the services could live with, even if not completely satisfied with the specific solution. The decision met two primary desires of the USDRE Office: reduced duplication of systems and preserved part of the Assault Breaker concept. The joint initiatives signed by the Chiefs were a big step in the direction of jointness that Congress and OSD had wanted for some time. Some within Congress and OSD had fought hard for radar identity between the services that the 707 provided, although they were not happy with the point solution chosen.⁶⁵

The Air Force, especially ESD, had wanted the 707 platform even before the joint program was put together, believing strongly in the value of wide area surveillance, autonomous missions, and command and control capabilities. TAC was not 'ecstatic' about spending a lot of money on a surveillance system, but they agreed the 707 was their platform of choice. TAC also could not stand overtly against such a system since they had

⁶⁵ Dr. Tegnalia Interview.

given the AirLand Battle Doctrine of the Army their verbal support, and that doctrine required a system like Joint STARS. TAC also agreed they did not want the Army to own the development of a fixed-wing aircraft program. So TAC stood behind the program decision, although they would not commit strong resources to the development of operational concepts or to funding for the program. After all, to TAC this appeared to be another Close Air Support type of system.

In June 1984, TAC and TRADOC signed a Memorandum of Agreement on Joint STARS directing the program office to develop a radar "optimized for the 707, unconstrained by power and weight limits," built to the full MTI, SAR, and weapons guidance capabilities. This was basically the same requirement that existed for the Pave Mover development in 1981. The aircraft was to be capable of distributing information to Army ground stations and "appropriately equipped Air Force C3I elements."

Also in June 1984, both General Stansberry and Colonel Hailey left ESD. General Stansberry was replaced by Lieutenant General Melvin Chubb and Colonel Hailey was succeeded by Colonel Harry Gillogly. General Chubb charged Gillogly with the task of getting the Joint STARS program on contract and through the Full Scale Development Decision. MITRE became increasingly important here as the military program management team changed frequently – the continuity and technical expertise provided by MITRE protected the program from experiencing a SOTAS-like fate.

As we have seen up to this point in the evolution of Joint STARS, TAC was never an ardent supporter of the program. TAC did not consider the program a top item in their prioritization of money and human resources, and because of the lack of focus on the program, TAC had not up to this point developed a plan for how they would use Joint STARS. Harry Gillogly described this lack of planning by TAC:

TAC didn't know how the Joint STARS data would be used, nor how it would be distributed or controlled. TAC didn't even know where they would send the data! They wanted to process the information on-board and distribute it via JTIDS, but JTIDS protocols and message types were still being debated with the Navy. Besides this, TAC was still not comfortable with using data links - they preferred voice communications. Therefore, many links ended up on board: HAVE QUICK, UHF, SCDL, JTIDS. The Air Force had a very poorly defined concept of operations.

In order to create some kind of useful system specification, the program office realized they had to help TAC put together an operational concept. ESD and MITRE ended up drafting the operational requirements and trying to get HQ TAC to sign off on them.

The program office was successfully at getting the first RFP out the door on 28 September 1984, only 70 days after the Chiefs had given informal direction for the new program. The RFP requested the multimode radar on four 707 platforms, and included the requirement for both the Army SCDL and the Air Force-favored JTIDS data links. The proposals were received from the contractors and evaluation of the proposals began by November 1984.

The cost proposals were within the expectations of the program office, but by early 1985, it was clear that Congress was not going to provide the program with the money

necessary to execute this effort. The program had not won the overwhelming support of Congress or OSD (or even many within the services). Money would be tight. At the end of March, General Chubb assembled a hasty Army/Air Force Joint STARS Requirements Review in Washington, DC. The goal of the review was to "scrub TAC/TRADOC system requirements with a view to reducing Full Scale Development costs."⁶⁶ Requirements needed to be removed, or 'scrubbed,' in order to meet the new funding profiles. The decision was made to reduce the number of development aircraft from four to two and to remove the weapons guidance capability (which had become controversial between the services anyway).

The program office put together an amendment to the RFP and sent it to the contractors in late April. The Source Selection Board at the program office warned that this must be the last change, because "after two and a half years, expectations were high and one or more of the contractors may be ready to throw in the towel if the contract is not awarded soon."⁶⁷

In order to create a program that would fit in the funding profile permitted by OSD and Congress, the program office had put together an ambitious acquisition strategy. First, the program office created very optimistic schedules for the development program.

According to Gillogly, these optimistic schedules justified lower funding requirements by underestimating the technical effort required. Later, if the funding requirements increase,

⁶⁶ Memorandum, "TCG Weekly Activity Report, 28 Mar -3 Apr 85," unsigned.

⁶⁷ "Minutes of the Joint STARS Source Selection Advisory Council (SSAC) Meeting of 10 Apr 85," Col. Gillogly, Director, Joint STARS Program, Deputy Commander for Tactical Systems, April 18, 1985.

the program could justify schedule slips. "This is how programs are kept alive." Indeed, in 1987, as the program suffered under schedule slips and funding increases, the System Program Director, Colonel Jack Colligan, stated, "I get a lot of help from the Pentagon because those who were around when the original decisions were made to put together the accelerated program knew it was a high risk... They tell me I can't apologize for missing some dates, because if we had made them it would have been a miracle."⁶⁸

Estimated costs were also kept down by requiring fewer development and production aircraft to meet the testing and operational needs. The original production 'requirement' was for ten operational aircraft. This few aircraft could never meet the true operational requirements, according to David Chu, who was the Assistant Secretary of Defense for Program Analysis and Evaluation at the time. Also, accomplishing the planned operational and developmental tests and evaluations, and a European Field Test Demonstration, with only two development aircraft would have been a miracle. But keeping the number of aircraft low made the funding profile more attractive and allowed the program to stay 'under the radar' when the Pentagon was looking to cut programs to meet their fiscal budget constraints.

During 1984-1985, people within Congress, OSD, and the services still held out against the program, particularly from a cost and vulnerability perspective. In my brief analysis of the history reports from October 1984 to September 1985, I counted at least 55 major

⁶⁸ "Test Aircraft, Radar Deliveries Cause Delays in Joint STARS Program," *Aviation Week and Space Technology*, July 4, 1988, Vol. 129, No. 1, p. 54.

briefings the program office had to provide within one year to external agencies that had some jurisdiction over a part of the program. Despite the Chiefs' decision on the program, Joint STARS still faced an uphill battle.

During the summer of 1985, the proposals were reviewed, and in August the Grumman/Norden proposal was the unanimous pick of the Source Selection Committee. Grumman and Norden provided a better technical proposal with a radar that met all multi-mode requirements. Also, they bid a firm fixed price for the fixed price incentive contract. This made the choice easy. The program office had received a technically superior proposal that provided low risk because of the fixed price which fit within the funding profile.

In July 1985, the program office briefed the Air Force and Army review boards on the Full Scale Development of the Joint STARS system. The boards released the program briefing for presentation to the Defense review board. In August 1985, the program office briefed the Defense board, headed by USDRE Dr. Donald Hicks. Interestingly, General Chubb realized that TAC still did not understand the operational requirements for the system and had Gillogly brief both the acquisition strategy and the operational requirements to the service and Defense boards.⁶⁹ This was another sign of TAC's lack of prioritization of the system, and was generally unheard of in full scale development decision hearings. Despite the lack of TAC involvement, Dr. Hicks accepted the findings of the briefing and gave his recommendation to the Secretary of Defense. On 26 September 1985, OSD signed the

⁶⁹ Harry Gillogly Interview.

Secretary of Defense Decision Memorandum (SDDM), which formally initiated the full scale development of Joint STARS. The final aircraft contract consisted of the multimode radar on two 707 platforms.

In late 1981, both the Army and Air Force had separate MTI programs that had solid designs and at least a loose coalition of support. From 1982-1985, the effort to impose jointness had cost almost four years of development time, kept the potential contractors on hold, and required excessive time and effort by DoD senior executives and general officers. The final solution was to give the development of the aircraft to the Air Force and the Air Force chose to build a system almost identical to their original Pave Mover Engagement System. A lot of time and effort had been wasted in the name of jointness to bring the program back to a single-service decision, divided along traditional service missions.

CHAPTER 6: CONCLUSIONS

This thesis has highlighted many of the difficulties and consequences of joint system development. The Army and Air Force had developed separate MTI system to support their individual operational requirements, and had prepared to enter full scale development when USDRE mandated the joint program in 1982. The result of the USDRE mandate was two years with little progress on joint requirements or system development. These two years cost an excessive amount of senior executive and general officer time and effort and required the potential contractors to "sit and wait" until the joint requirements were settled. By March 1984, the result of the joint mandate was an RFP for three platforms: one similar to the Army SOTAS, one similar to the Air Force Pave Mover, and one similar to an intelligence aircraft. USDRE had created a joint program office, but could not enforce a joint program.

The jointness problem was only resolved after the Chiefs of Staff of the Army and Air Force announced 31 Initiatives that divided the Army and Air Force missions and systems along traditional service lines. Joint STARS fell out of the Chiefs' 31 Initiatives as a decision that met the traditional service division of responsibility. The Air Force was given the aircraft procurement of a system very similar to Pave Mover, and the Army was given independent control of the ground station procurement and the promise that the aircraft would provide dedicated support to Army ground commanders. The effort to impose jointness had caused a four-year delay in development, had cost a great deal of

time and money, and was only settled by the services' decision to develop the system under traditional service methods.

Even the Chiefs' decision did not completely resolve the difficulties within the program. The program still faced the disinterest of TAC and the dissatisfaction of those within Congress and OSD who had a different vision of the program's joint capabilities and intelligence potential. TAC had difficulty with the program because it didn't fit their central roles and missions. The system did not fit well within TAC's air superiority mission, but was more of a Close Air Support system. The Joint STARS mission also did not fit within the traditional division of tactical warfare and intelligence roles and missions. Furthermore, the technology and its applications did not come out of the traditional requirements process or qualify as a "next generation" weapon system. In summary, TAC did not know what to do with this system, and did not want to commit heavy resources to its development.

At the same time, TAC could not object to the Chiefs' decision to give the program to the Air Force. TAC had given their verbal support to the AirLand Battle Doctrine, and the doctrine required the capability that a system like Joint STARS provided. Joint STARS was also a key, high-visibility program in the 31 Initiatives as an answer to Congressional and OSD concerns regarding jointness. In addition, TAC realized that if the Army picked up the program, this would provide them with a fixed-wing aircraft development effort, which was highly discouraged within the Air Force..

As a result, TAC gave their support to the Joint STARS program, but not as a high priority on their requirements list. This resulted in stretched development schedules in order to meet funding profiles as well as a lack of clear operational concepts and requirements from the TAC staff. In order to overcome these difficulties, ESD increased its advocacy and creative acquisition management of the system to keep the program alive and moving forward.

Joint STARS highlights the difficulties of joint system development and the difficulties of developing innovative systems that do not meet traditional service missions. The difficulties are due to the fact that the services, and even the different operating commands, often have deeply held beliefs about operational, doctrinal, and technical characteristics of their systems and programs. Attempts to force changes in these deeply held beliefs in the name of jointness is very costly and ineffective. In the case of Joint STARS, the better answer was to select one service to do the job and to match the system with a single organization that would best, and perhaps more traditionally, perform that mission. The Air Force was given the fixed-wing aircraft program and the Army the ground station development.

Within the Air Force, the intelligence community may have seemed the better fit for a surveillance platform, but they did not have the desire to provide real-time battlefield support nor the strong funding to keep the program alive. TAC was the better choice, and

decisions regarding the system were made in order to fit the program better to a traditional tactical mission. Supporters referred to the aircraft as an "upside-down AWACS" in order to associate the system with the already-successful TAC surveillance system. ESD also emphasized the potential support that Joint STARS provided for tactical interdiction by F-15 and F-16 fighter aircraft, and put the word "Attack" in the system's title (Joint Surveillance Target *Attack* Radar System; the "A" once referred to *Acquisition*.) to emphasize this mission. Today, battlefield command and control has become a larger part of TAC's mission and interest, but in the early 1980s, TAC was seeking to build a large number of fighter wings; therefore, ESD needed to work very hard to tie this program to the tactical warfare mission in order to encourage support.

The joint system requirements resulted in significant and costly delays and the lack of a traditional mission further complicated the development and production program. Despite the efforts to tie the program closer to traditional service missions, the program has progressed slowly. At the time of this writing, the Joint STARS program is entering its thirteenth year of development and production since the full scale development decision was made in 1985. Only one production aircraft has currently been released to the field and the procurement schedule over the next several years will be two or three planes per year to stay within the funding profile. The total system cost is now estimated at \$20 billion dollars, and the Army and the Air Force are still wrestling over specific operational concepts for the program. The fact that the program is still alive is a testament to the

efforts of ESD to sustain the system development, but the evolution of the program has been very slow and very costly.

APPENDIX 1: LIST OF INTERVIEWS

Name	Relation to Joint STARS
Mr. David Chu	Assistant Secretary of Defense for Program Analysis and Evaluation (ASD/PA&E), 1981-1993
Dr. Gary Comfort	Program Element Monitor for Standoff Weapons Systems, 1979-1982
Mr. John Entzminger	Pave Mover (and predecessors) Program Manager, 1972-1978
Colonel Harry Gillogly, USAF (Ret)	Joint STARS System Program Director, 1984-1985
Brigadier General David Herrelko, USAF	Program Element Monitor for Standoff Weapons Systems, 1982-1985
Colonel Charles Jaglinski, USAF (Ret)	Pave Mover and Joint STARS System Program Director, 1979-1983
Mr. William Kenneally	SOTAS Program Manager and Army staff on Joint STARS, 1974-1979, 1983-1985
Mr. James Kuhn	MITRE Engineer, Joint STARS Joint Program Office, 1982-1997
Mr. Gary Lewitzky	MITRE Engineer, Joint STARS Joint Program Office, 1980-1997
General Robert T. Marsh, USAF (Ret)	ESD Commander, 1977-1981 AFSC Commander, 1981-1984
Colonel G. Sidney Smith, USA (Ret)	Joint STARS Deputy System Program Director, 1983-1987
Lt. General James W. Stansberry, USAF (Ret)	ESD Commander, 1981-1984
Mr. Melvin Stone	Lincoln Laboratory Radar Engineer, 1970s
Dr. James Tegnolia	DARPA Assault Breaker Program Manager, 1976-1982, DUSDRE (Conventional Initiatives) 1982-1986
Major General Jasper Welch, USAF (Ret)	Assistant Deputy Chief of Staff for Research, Development, and Acquisition, 1982-1983

APPENDIX 2: ACRONYM LIST

ADM	Advanced Development Model
AFSC	Air Force Systems Command
ALARM	Airborne Long-range Alerting Radar for MTI
ALFA	AirLand Forces Application
ALSS	Advanced Location Strike System
ASARS	Advanced Synthetic Aperture Radar System
ASD	Aeronautical Systems Division
AWACS	Airborne Warning And Control System
CINC	Commander-in-Chief
D3	Deployable Development and Demonstration
DA SOTAS SAG	Department of the Army SOTAS Study Advisory Group
DARCOM	Department of the Army Research Command
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
ECCM	Electronic Counter Counter Measures
ERADCOM	Electronic R&D Command
ESCAN	Electronically Scanned
ESD	Electronic Systems Division
FEBA	Forward Edge of Battle Area
FOFA	Follow-On Forces Attack
FTI	Fixed Target Indicator
GPS	Global Positioning System
HASC	House Armed Services Committee
HPSCI	House Permanent Select Committee on Intelligence
IDL	Interoperability Data Link
IOC	Initial Operating Capability
JAIO	Joint Assessment and Initiatives Organization
JFDG	Joint Force Development Group
Joint STARS	Joint Surveillance Target Attack Radar System
JPO	Joint Program Office
JTIDS	Joint Tactical Information Distribution System
MASR	Multiple Antenna Surveillance Radar
MICNS	Modular Integrated Communication and Navigation System
MLRS3	Multi-Lateration Radar Surveillance and Strike System
MTI	Moving Target Indicator
O&C	Operations and Control
OPSDEPs	Deputy Chiefs of Staff for Operations and Plans
OSD	Office of the Secretary of Defense
PLSS	Precision Location Strike System
RADC	Rome Air Development Center
REA	Radar Evaluation Activity
RFP	Request for Proposal

RSTA	Reconnaissance, Surveillance, and Target Acquisition
SAC	Strategic Air Command
SAR	Synthetic Aperture Radar
SASC	Senate Armed Services Committee
SCDL	Surveillance and Control Data Link
SLAR	Side-Looking Airborne Radar
SOTAS	Stand-Off Target Acquisition System
SSCI	Senate Select Committee on Intelligence
TAC	Tactical Air Command
TRADOC	Training and Doctrine Command
USDRE	Under Secretary of Defense for Research and Engineering